REMARKS

Reconsideration of this application as amended is respectfully requested.

Claims 21-37 are pending. Claims 21-37 stand rejected.

Claims 21 and 29 been amended. Claims 36 and 37 have been cancelled. Support for the amendments is found in the specification, the drawings and in the claims as originally filed. Applicants submit that the amendments do not add new matter.

Applicants have amended the claims to include the limitation that the connection of the exhaust line is such that the gas has a tendency to flow directly toward the exhaust line and that a flow pattern is created which counteracts this tendency. Applicants respectfully submit that the amendments more distinctly claim the invention. Support for the amendments is found in the specification at paragraphs 3 and 30.

> "Because the exhaust line 330 is connected to a location on a left-hand side of the chamber 318, there is a tendency for flow over the wafer 312 to be more to the left."

(Specification, page 2, paragraph 3)

> "The circular movement in the direction 76 counteracts a tendency of the gas to flow directly towards the exhaust line 22."

(Specification, page 11, paragraph 30)

Given this support, applicants respectfully submit that the amendments do not add new matter.

Rejections Under 35 U.S.C. § 102(e)

Claims 21-28 and 36-37 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,403,491, of Liu ("Liu"). The Examiner stated that

Liu teaches a wafer processing apparatus (Figure 2) comprising:

i. A processing chamber (100; column 10, lines 20-65) defined by walls

ii. A wafer supply opening (139) formed in one of the walls for transferring a wafer (10) into the chamber

iii. A susceptor (55, Figure 21) in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall of the chamber (Figure 2)

iv. A manifold component (102; Figure 2, 4; column 12, lines 9-62) located on the chamber and, together with the upper surface of the upper wall, define a manifold cavity (conduits between 103 and volume 112; Figure 4)

v. A gas supply line (212; Figure 4) connected to the manifold component, wherein the upper wall (134, 710, 220; column 10, line 66 – column 11, line 15; Figures 7a-f, 8-11) has a plurality of gas supply openings, substantially equal in size, (340, 350a, 348; Figure 4, 7a,b; 225, Figures 8-11), each formed into an upper surface and out of a lower surface thereof, lower ends (714, 716; Figure 7b; 727, Figure 7c; 220a; Figure 10) of at least some of the gas supply openings extending at an angle other than at right angles relative to the upper surface of the wafer so that a gas, when exiting the openings flows at an angle other than at right angles relative to the upper surface of the wafer (column 14, lines 34-36; column 15, lines 38-50)

vi. An off-center exhaust line (114) connected to the gas chamber, for flowing a gas from the chamber

vii. First (first 350a; Figure 4; 225; Figures 8-11) and second (second 350a; Figure 4; 225; Figures 8-11) ones of the openings on opposite sides of a point (traversed by symmetry axis of 134, through the geometric center of plate 220; Figures 8-11) on the upper wall, the first and second opening (714, Figure 7b; 225; Figure 10) having a lower end (bottom surface of 134, 225; Figure 10) which is angularly and oppositely displaced relative to an upper end (top surface of 134; 220) thereof in a selected direction about the point so that the openings jointly create a circular gas flow pattern in the chamber (column 16, lines 49-63; Figure 9, 10)

viii. A third of the openings (225; Figures 8-11) on a side of the second opening opposing the first opening, has a lower end which is displaced in the first direction relative to an upper end thereof

ix. A channel (114; Figure 4) is defined within the chamber, the channel being concentric with the wafer (Figure 2), gas flowing radially outward

> over the wafer into the channel, and from the channel to the exhaust location and into the exhaust line (Figure 2).

(Office Action mailed January 6, 2003, page 2, paragraph 2-page 3)

Applicants respectfully submit that claims 21-28 are not anticipated by Liu under 35 U.S.C. 102§(e). Amended claim 21 includes the following limitations:

> A wafer processing apparatus comprising:
>
> a processing chamber defined by a lower wall, an upper wall and side walls extending from the lower wall to the upper wall, a wafer supply opening being formed in one of the walls for transferring a wafer into the chamber;
>
> a susceptor in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall;
>
> a manifold component located on the chamber and, together with the upper surface of the upper wall, defining a manifold cavity;
>
> an exhaust line connected to the gas chamber, for flowing a gas from the chamber, connected such that the gas has a tendency to flow toward the exhaust line; and
>
> a gas supply line connected to the manifold component, wherein the upper wall has a plurality of gas supply openings, each formed into an upper surface and out of a lower surface thereof, lower ends of at least some of the gas supply openings extending at an angle other than at right angles relative to the upper surface of the wafer so that a gas, when exiting the openings, flows at an angle other than at right angles relative to the upper surface, to create a flow pattern from the openings which counteracts the tendency of the gas to flow toward the exhaust line, and thus promotes even processing over the upper surface of the wafer.

(Amended claim 21) (Emphasis added)

Applicants respectfully submit that claim 21, as amended, is not anticipated by Liu. Liu does not disclose a plurality of gas supply openings, formed into an upper surface and out of a lower surface of an upper wall of a processing chamber. The gas supply openings (passages) of

Liu are formed within a nozzle and not formed within the upper wall. In Liu, the upper wall has at least one liner. The liner has apertures that are fitted with nozzles (for the embodiments of Figures 4 and 7a-7f). Liu discloses

> In one embodiment, the plurality of apertures 348 is disposed at least partially in the center depression 336. The apertures 348 are generally positioned in a polar array about the center of the first liner 134, although other positional locations may be utilized. Each aperture 348 is fitted with a nozzle 350*a*. The nozzles 350*a* facilitate distribution of process and other gases from within the plenum 338 to the process volume 112 of the chamber 100. The nozzle 350*a* is generally fabricated from a non-conductive material, such as quartz, silicon carbide, silicon, aluminum nitride, aluminum oxide, Y2O3, Boron Carbide, or other materials such as sapphire.
>
> FIGS. 7*a*-7*f* depict various alternative embodiments of the nozzle 350*a* that advantageously minimize recirculative gas flows within the chamber. While reference numbers 350 and 350*a* are used, it is to be appreciated that alternative nozzles 350*b* to 350*f* may be used. Turning now to FIG. 7A. In one embodiment of the nozzle illustrated in FIG. 7A, the nozzle 350*a* includes a mounting portion 717 and a gas delivery portion 715 that is in communication with the chamber volume 110. The mounting portion 717 has a flange 710 extending from the perimeter of the nozzle 350*a* typically towards the side of the nozzle 350*a* exposed to the plenum 338. The nozzle 350*a* additionally comprises a central passage 724 that fluidly couples the plenum 338 to the chamber volume 110.

(Liu, Col. 14, lines 22-47) (Emphasis added)

This passage of Liu, in conjunction with Figures 4 and 7a-7f of Liu, makes clear that it is the nozzles that have the passages that the Examiner is equating with the gas supply openings of the claimed present invention.

For the embodiments of Figures 8-11, the nozzle is replaced by a mini-gas distribution plate. Liu discloses

> Additional alternative embodiments of the gas distribution system are illustrated in FIGS. 8-13. In FIGS. 8-13, in lieu of nozzles 350, mini-gas distribution plates 220 having plural gas injection holes 225 are provided in center section 310 of liner 134 to fluidly couple plenum 338 and the chamber volume 110.

(Liu, Col. 15, lines 60-65) (Emphasis added)

Again, it is clear that it is the gas injection holes of the mini-gas distribution plate that the Examiner is equating with the gas supply openings of the claimed present invention.

In either case, the passages or the gas injection holes are not formed within the upper wall of the chamber, nor are they formed within the chamber liner, but instead are formed within nozzles and mini-gas distribution plates, respectively.

For these reasons, applicants respectfully submit that claim 21 is not anticipated by Liu. Given that claims 22-28 depend directly or indirectly from claim 21, applicants respectfully submit that claims 22-28 are likewise not anticipated by Liu.

Rejections Under 35 U.S.C. § 103(a)

Claims 29-35 stand rejected under 35 U.S.C. § 103(a) as being obvious over Liu in view of U.S. Patent No. 5,248,371 of Maher et al. ("Maher").

It is also respectfully submitted that Liu does not teach or suggest a combination with Maher and that Maher does not teach or suggest a combination with Liu. It would be impermissible hindsight based on applicants' own disclosure to incorporate the high-energy density uniformizing grid of Maher into the nozzles or mini-gas distribution plates of Liu. Moreover, such a combination would still lack the limitation of a plurality of gas supply openings formed into an upper surface and out of a lower surface of an upper wall of a chamber.

In rejecting claims 29-35 under 35 U.S.C. § 103(a) as being unpatentable over Liu in view of Maher, the Examiner has stated that

> Liu only teaches uniformly distributed gas supply openings as discussed above. Additionally, Liu does not teach that the openings are more densely located in the upper wall than on the other side thereof. Liu does not teach the flow regime of operation as being either laminar or turbulent. Maher teaches a similar gas distribution plate (90; Figure 4a) which has non-uniformly distributed gas supply openings (92, 94).

> It would have been obvious to one of ordinary skill in that art at the time the invention was made for Liu to relocate his gas supply openings so that they are unevenly distributed and to operate his apparatus such that the flow within the chamber is laminar.
>
> Motivation for Liu to relocate his gas supply openings so that they are unevenly distributed is to provide for a desired flow pattern within the reactor. Motivation for Liu to operate his apparatus such that the flow within the chamber is laminar is to provide for optimized operation of the apparatus, (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc. v. Biocraft Laboratories Inc., 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989); In re Kulling, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

(Office Action mailed January 6, 2003, page 4, paragraph 3-page 5)

Applicants respectfully submit that amended claim 29 is not obvious under 35 U.S.C. § 103(a) in view of Liu and Maher. Amended claim 29 includes the following limitations.

> A wafer processing apparatus, comprising:
>
> a processing chamber defined by a lower wall, an upper wall and side walls extending from the lower wall to the upper wall, a wafer supply opening being formed in one of the walls for transferring a wafer into the chamber;
>
> a susceptor in the chamber on which the wafer can be located so that an upper surface of the wafer faces the upper wall;
>
> a manifold component located on the chamber and, together with the upper surface of the upper wall, defining a manifold cavity;
>
> an exhaust line connected to the gas chamber, for flowing a gas from the chamber, connected such that the gas has a tendency to flow toward the exhaust line; and
>
> a gas supply line connected to the manifold component, <u>wherein the upper wall has a plurality of gas supply openings, each formed into an upper surface and out of a lower surface thereof, the gas supply openings being nonuniformly distributed over the upper wall</u> to create a flow pattern that counteracts the tendency of the gas to flow toward the exhaust line, and thus promotes even processing over the upper surface of the wafer.

(Amended Claim 29) (Emphasis added)

The gas supply openings of Maher are not distributed over the upper wall, but only distributed over a grid mounted within the reactor. The grid is mounted within the reactor and the openings are distributed across the grid. It is clear, therefore, that the openings of Maher are not within the upper wall of a chamber.

Additionally, an uneven distribution of gas supply openings in the system of Liu would defeat the purpose of Liu by increasing flow recirculation. The purpose of the gas supply openings of Liu is to decrease flow recirculation and hence reduce by-products drawn up toward the lid of the chamber.

Moreover, there is no motivation to combine, as the grid in Maher is used for a totally different purpose than the nozzles or mini-gas distribution plates of Liu. The grid of Maher is used to provide a uniform high-energy-density hollow-anode glow discharge, whereas the nozzles and mini-gas distribution plates of Liu are used to minimize flow recirculation, as discussed above.

For these reasons, applicants respectfully submit that amended claim 29 is not rendered obvious under 35 U.S.C. § 103(a) by Liu in view of Maher. Given that claims 30-35 depend directly or indirectly from claim 29, applicants submit that claims 30-35 are likewise not rendered obvious under 35 U.S.C. § 103(a) by Liu in view of Maher.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

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